Butterflies that are Endangered, Threatened, and of Special Concern in Ohio[1]

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ABSTRACT. Four butterflies are endangered in Ohio. Three of these, *Erynnis persius* (Scudder), *Incisalia irus* (Godart), and *Lycaeides melissa samuelis* Nabokov, are restricted to the Oak Openings and use *Lupinus perennis* L. as the larval host. These species require early successional habitats and have probably declined since fire was eliminated as a factor in the ecology of the Oak Openings. The fourth endangered species, *Calephelis muticum* McAlpine, is currently known from two fens in west-central Ohio. The single threatened species, *Boloria selene* (Denis and Shiffermüller) was once widespread in Ohio, but is now known from only three or four counties. Species of special concern occupy very limited ranges (*Pyrgus centaureae wyandot* [Edwards], *Euchloe olympia* [Edwards], *Satyrium edwardsii* [Grote and Robinson], and *Speyeria idalia* [Drury]). Extirpated species include *Neonympha mitchellii* French, *Pieris napi* L., and *Speyeria diana* (Cramer). Several species (*Erynnis lucilius* [Scudder and Burgess], *Amblyscirtes belli* Freeman, *Pontia protodice* [Boisduval and LeConte], *Erora laeta* [W. H. Edwards], *Lycaena epixanthe* [Boisduval and LeConte], and *Phyciodes pascoensis* Wright) are vaguely recorded from Ohio, but could be very rare residents deserving protected status once more of their biology is known.

Two major threats to butterfly diversity in Ohio are identifiable. Uncontrolled succession in the Oak Openings may eliminate those species that require the unique, early successional communities found there. Widespread insecticide application for gypsy moth (*Lymantria dispar* [L.]) control in southern Ohio could negatively impact sensitive butterfly populations and other sensitive anthropods.

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INTRODUCTION

There has been considerable activity aimed at identifying and evaluating rare and endangered taxa in Ohio during the last 13 years. Predictably, early emphasis was placed upon vertebrates (Smith et al. 1973), but recently, definitive treatments of plants have appeared (Cooperrider 1982, McCance and Burns 1984). Jezerinac's (1986) discussion of endangered and threatened crayfishes was the first authoritative treatment of imperiled invertebrates in Ohio. Shuey et al. (1987) considered the status of eight species of Lepidoptera that are potential candidates for addition to the U.S. list of endangered species, including three of the species discussed here.

The history of Lepidoptera conservation is extensive, although most conservation efforts have been limited to North America and Europe (Pyle 1976, Pyle et al. 1981, Thomas 1984). Recently, a few tropical countries have become interested in Lepidoptera conservation, most notably Papua New Guinea (Parsons 1984), Brazil (Otero and Brown 1982-84[86]), and Mexico (Norman 1986). Butterflies are viewed increasingly as conspicuous components of ecosystems, and as such, endangered butterflies can be valuable tools for preserving endangered communities. Butterflies are taxomomically well known, a group rich in species, with a wealth of distributional data available relative to other terrestrial invertebrates. Thus, they are uniquely qualified as environmental indicators. This paper is the first to examine the status of rare butterflies and skippers in Ohio and is the first such treatment of a major group of terrestrial invertebrates in the state. Included in each species discussion is an overview of status, ecological requirements, and factors negatively impacting their continued survival.

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MATERIALS AND METHODS

Specimen records were recorded from virtually all known public and private collections available in Ohio and are a subset of the data recorded for the survey of Ohio Lepidoptera, a project sponsored by the Ohio Lepidopterists. To date, over 15,000 butterfly records have been verified and recorded.

Habitat requirements are based upon field observations except as noted. We have experience in Ohio with all the endangered, threatened, and potentially threatened species and have observed all of Ohio's extirpated species in adjacent states.

All of the species included are considered to be resident species, or potential residents in the case of some of the species whose status is undetermined. The species are grouped into five categories based upon the number of known populations and the perceived susceptibility of the populations to perturbations that could lead to their extinction. **Endangered** species are all known from five or less populations, and have very limited ranges in Ohio. These species occupy unique habitats, ones that are susceptible to disturbance or other factors that could render them unsuitable for the continued existence of the butterflies. The single **threatened** species [*Boloria selene* (Denis and Schiffermüller)] in Ohio is included because of its precipitous range decline within the state, the cause of which remains unknown. Viable populations of this species occur in only a fraction of its historical range in Ohio, and its decline may continue to the point of extirpation. **Species of special concern** in Ohio are those that occupy very limited ranges in the state and for which identifiable threats may exist. In one case, the species has undergone a range contraction in Ohio, but not to the point that it is in immediate danger of extinction. **Extirpated** species are those that were once resident in the state, but for which there are no recently known populations. Species that are vaguely recorded from Ohio, but which could be very rare residents, are included under **status unknown.**

The nomenclature follows Opler and Krizek (1984). Subspecific names are used only for those taxa for which the specific vs. subspecific status is currently unsettled.

RESULTS

ENDANGERED SPECIES IN OHIO

Erynnis persius (Scudder) - Persius Dusky Wing

Historical Occurrence in Ohio: This species has never been reliably reported outside of the Oak Openings of Lucas County and is one of the butterflies that characterize this region of Ohio. Price (1970) reported cap-

turing only two specimens (a third specimen mentioned by Price has since been determined by Dr. J. Burns as probably *Erynnis lucilius* [Scudder and Burgess]).

Three old reports of this species from Pickaway (Bales 1909), Summit (Hine 1898a), and Seneca counties (Henninger 1910) probably refer to *Erynnis baptisiae* Forbes, a common and closely related species that was not yet described at the time that these papers were published. *Erynnis persius* is single brooded, flying only in mid-spring. Specimens captured after this period are referable to other *Erynnis* species.

Current Status in Ohio: There are only two known active populations in and around the Oak Openings Metro Park in Lucas County.

Habitat Requirements: This species is limited to areas with its abundant host plant, lupine, (*Lupinus perennis* L.), which is a potentially threatened plant in Ohio (Cooperrider 1982). The two known populations occur in oak savanna and dune communities.

Reasons for Decline: The biology of *E. persius* is poorly known, so the factors responsible for its decline are not understood. However, it is clear that as lupine becomes shaded through natural succession, the habitat becomes less suitable for *E. persius*. Thus, the main reason for decline of this and the other lupine-feeding butterflies is probably the recent advent of fire suppression, which results in the eventual shading of the lupine stands. The past policy of the Toledo Metropolitan Park System, which owns many of the former population sites of this and the other lupine-feeding butterflies, has been to eliminate fire from the ecology of all the land under its care. This has resulted in many ecological changes, of which the decline of lupine-feeding butterflies is only one.

Incisalia irus (Godart) - Frosted Elfin

Historical Occurrence in Ohio: Except for two records from Cincinnati, (a specimen dated May, 1937, and a literature report [Dury 1900]), all of the known captures are from the Oak Openings in Lucas County. In the 1930s this species was very common and widespread in the Oak Openings (J. Thomas, pers. comm.). During the 1960s, Price (1970) knew of only two small colonies, both associated with large stands of the host plant, lupine (*L. perennis*).

Current Status in Ohio: This species is presently known from a few sites in and around the Oak Openings Metro Park, Lucas County. Several recently active populations in the Oak Openings Metro Park have become extinct (T. Carr, pers. comm.).

Habitat Requirements: This species is limited to xeric dune communities where lupine is common. The adults oviposit on the flower buds, which, along with the developing seed pods, are the sole food of the larvae. This species is efficient in using small stands of lupine, and hence is the most widely distributed of the lupine-feeding butterflies within the Oak Openings.

Reasons for Decline: Since the larvae feed only on flowers and seed pods of lupine, any factor that impacts on host plant reproduction will also have a profound effect on *I. irus*. Shading of the host plant through natural succession is probably the primary factor reducing lupine reproduction. Therefore, fire suppression is a likely cause for the decline of this butterfly.

Lycaeides melissa samuelis Nabokov - Karner Blue

Historical Occurrence in Ohio: This species has never been captured outside of the Oak Openings of Lucas County and is one of the characteristic butterflies of the region. A record in Albrecht (1982) from Summit County is based on a misidentification. In the early 1940s, this species was widespread and very common in the Oak Openings (J. Thomas, pers. comm.). Price (1970) reported that it "varies greatly in numbers from year to year, but it is sometimes common at the Oak Openings."

Current Status in Ohio: Possibly extirpated; one adult male was seen in 1986 at the only known population site, Kitty Todd Preserve. As recently as 1983, a seemingly viable population existed on and adjacent to the preserve. Since that time very few adults have been seen. In 1986 only one adult male was observed during an entire season of close scrutiny. This population is best considered either extinct or on the verge of extinction. The few known population sites in the Oak Openings Metro Park have not been active for approximately 10 years (T. Carr, pers. comm.). Given the highly local nature of this species, it seems possible that unknown populations may yet survive. The last known population occupied an area of less than 2 ha. Efforts should be directed at locating similar areas within the Oak Openings.

Habitat Requirements: This species requires relatively large expanses of the host plant, lupine (*L. perennis*). Adults will apparently not use shaded host plants as oviposition sites, severely limiting the number of suitable habitats available (see Discussion under *E. persius*). Populations are very localized around the host plants, but healthy populations in other areas attain high densities, with 20 or more adults visible at any given moment.

Reasons for Decline: The primary factor in the decline of *L. m. samuelis* is probably fire suppression in the Oak Openings area, as is the case for *E. persius* and *I. irus*. This is the most susceptible of the three lupine feeders to habitat shading, and is the first to become locally extinct.

Calephelis muticum McAlpine - Swamp Metalmark

Historical Occurrence in Ohio: This species has been recorded from two sites in Champaign County, and one site in southern Logan County (Albrecht 1974, 1982). A literature record from Seneca County (Porter 1965) has not been verified, but Springville Marsh, a once extensive fen complex in southern Seneca County, may have been suitable habitat in the past. Unfortunately, Springville Marsh is now highly disturbed and the fen meadows that might have supported *C. muticum* are gone. Additional literature records from Hamilton (Albrecht 1982) and Shelby counties (Hoying 1975) are based upon misdeterminations. Ehrlich and Ehrlich (1961) also reported this species from "near Cincinnati" but this is probably a poor geographic reference to the Cedar Bog population in Champaign County.

Current Status in Ohio: There are two active populations, the best known of which occurs in Cedar Bog State Memorial, Champaign County (Albrecht 1974). A second population occurs in a fen in Logan County. Fens at Kaiser Lake State Park, Champaign County, once supported a population, but recent attempts to rediscover this population have been unsuccessful. There are probably other populations in the fens of west-central Ohio, but populations are easily overlooked because of the diminutive size of this butterfly and its low population densities.

Habitat Requirements: This species uses swamp thistle, (*Cirsium muticum* Michx.) as the larval host. In the Great Lakes region, *Cirsium muticum* is considered a typical plant of alkaline peat deposits (fens) (Stuckey and Denney 1981), and *Calephelis muticum* is restricted to this habitat type (Shuey 1985).

Reasons for Decline: This species has undoubtedly suffered population losses owing to habitat modification, a problem that still exists. Many of the fens in west-central Ohio have been altered or destroyed by draining or flooding (see Andreas 1985). Certainly, the creation of Kaiser Lake over the large fen complex that once existed there did not benefit this species. The population discovered there in the 1960s was probably a small remnant of the pre-lake population.

An additional threat to this species is collecting pressure. This species is one of two members of the subfamily Riodininae in Ohio, and is very desirable to collectors from that standpoint. Where it occurs, the species is very localized, usually occupying less than 1 or 2 ha, and occurs at very low population densities (generally six or fewer adults visible/h). Thus, known populations are very susceptible to collecting pressures. Conversely, the population structure and appearance of this butterfly have probably resulted in many populations being overlooked by casual collectors.

Threatened Species in Ohio

Boloria selene (Denis and Schiffermüller) - Silver-bordered Fritillary

Historical Occurrence in Ohio: This species was once locally common from northern Ohio south to Columbus and Dayton (Fig. 1), and older literature records abound. Hine (1898a) reported it from Summit, Hamilton, and Franklin counties; Kirtland (1854) and Pilate (1882) reported it from Montgomery County; Claypole (1897) listed it as common in Summit County; Henninger (1910) reported it in Seneca County. Price (1970) reported that this species occurred sporadically from northwest Ohio, and noted that it was occasionally common at Mud Lake, Williams County. The population at Cedar Bog, Champaign County, apparently became extinct approximately 15 years ago (Drees 1982), although we have seen a specimen (probably captured in 1984) from a nearby fen in Logan County. Nothing is known of the causes of this range contraction.

Status in Ohio: The only known extant populations are in the Oak Openings (Lucas and Fulton counties), a wetland in Trumbull County, and possibly a fen in Logan County (Fig. 1). There may be additional populations in the wetlands of northeastern Ohio.

Habitat Requirements: In the Oak Openings, this species is common in wet, early succession fields dominated by native species. In northeastern Indiana and southern Michigan, *B. selene* is more often associated with sedge meadows and fens. These are the habitats of this species in Trumbull County. Andreas (1985) considered some of the botanical communities in which this species occurs in the Oak Openings as fen remnants. In general, these communities seem highly divergent from typical fens, yet there are shared key species. Perhaps some clue to the decline of this butterfly may yet be drawn from the distribution of its remaining viable populations.

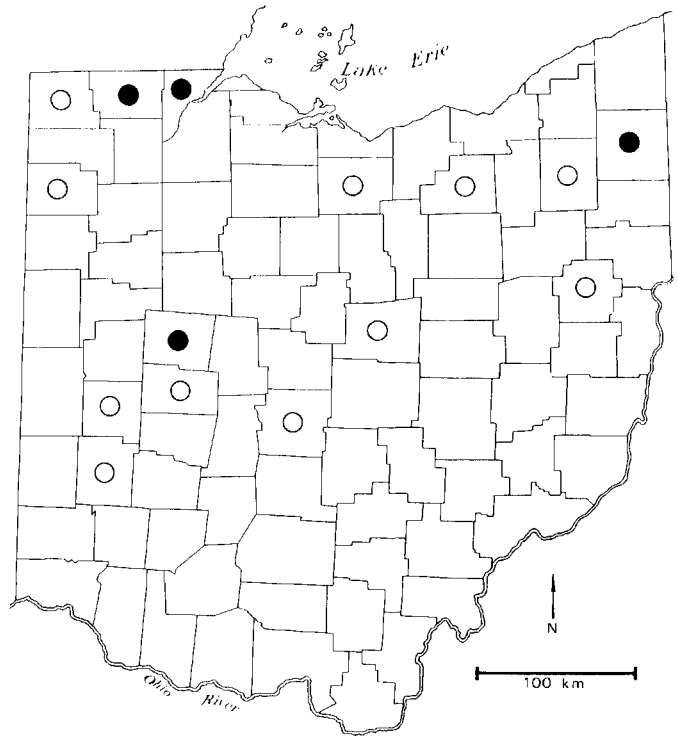

FIGURE 1. The distribution of *Boloria selene* in Ohio. Open circles represent historical records; closed circles represent known viable populations.

The host plants of this species are reported to be several species of violets (*Viola*) (Howe 1975). In Lucas and Fulton counties, *Viola lanceolata* L. is common at sites where we have encountered this butterfly, and at Kitty Todd Preserve (Easterly 1983) where *B. selene* is very common. Several adults have been observed hovering over this violet, indicating that this may be the primary host in the Oak Openings. *Viola lanceolata* occurs in open, moist habitats, usually in acidic substrates. *Viola lanceolata* is itself a threatened species in Ohio (McCance and Burns 1984), where it has undergone a range contraction. If *V. lanceolata* is the host plant in the Oak Openings, then some other *Viola* species is used in fens and sedge meadows. Two fens that at one time harbored populations of *B. selene* are well known botanically, and *V. lanceolata* is not reported from either Mud Lake (Brodberg 1976) or Cedar Bog (Frederick 1974).

Reasons for Decline: At this time, too little is known about the biology and ecology of this species in Ohio to speculate on the factors that are reducing its range. If *V. lanceolata* is a host of this butterfly, some of the range contraction may be attributed to the decline of this plant. However, this does not explain the disappearance of *B. selene* from habitats where *V.*

lanceolata does not occur. It is possible that agricultural drainage has eliminated the moist habitats that this species requires.

SPECIES OF SPECIAL CONCERN IN OHIO

Pyrgus centaureae wyandot (Edwards) - Grizzled Skipper

Historical Occurrence in Ohio: This species is known from only four sites in Ohio: Lake Hope State Park (Vinton County) (Wagner and Showalter 1976); The Plains (Athens County) (Shuey 1983); south of Logan (Hocking County) (J. Peacock pers. comm.); and an old record (10 May 1916) from Lakewood (Cuyahoga County).

Current Status in Ohio: With the exception of the Lakewood record, all of the known sites are based upon recent records and are presumed to represent viable populations. Because this species is easily overlooked and occurs at low population densities, we feel that there are probably several other populations within this limited geographical area. The Lakewood record indicates that it may occur much more widely in the state.

Habitat Requirements: This species is presently known only from open ridge tops within mature deciduous forests in Ohio. At the three known population sites, it is closely associated with its presumed host plant, dwarf cinquefoil (*Potentilla canadensis L.*). In Michigan, wild strawberry (*Fragaria virginiana* Duchesne) is the host plant, and might also support populations in Ohio.

Potentials for Decline: Because of the limited distribution of this species, its occurrence in small clearings within deciduous forests, and its early spring-feeding larvae, it is highly susceptible to aerial applications of pesticides used for gypsy moth (*Lymantria dispar* [L.]) control. Although spraying is not yet a threat to this species, current practices in northeastern Ohio indicate that if the gypsy moth spreads to southern Ohio, widespread control measures with the compound diflubenzuron (trade name Dimilin) can be expected. Dimilin is a synthetic chitin synthesis inhibitor that interferes with molting in larvae (Matsumura 1985). It is usually applied in spring when *L. dispar* larvae are most susceptible. Widespread application of this compound in southern Ohio could negatively affect most arthropod species present as larvae when the compound is applied.

Euchloe olympia (Edwards) - Olympia Marblewing

Historical Occurrence in Ohio: This species was only recently discovered in Ohio at Lake Vesuvius, Lawrence County (Riddlebarger 1984).

Current Status in Ohio: *E. Olympia* is still too poorly known in Ohio for us to classify its status. Since its initial capture, a few additional specimens have been taken, expanding its known range to a few miles north of Lake Vesuvius. Captures in 1985 confirmed its resident status.

It is possible that this species occurs more widely in Ohio, but is overlooked. Our experience over two years indicates that it occurs in very low densities. Several man-hours of search time are required to collect each specimen. Complicating this situation is a closely related species, *Falcapica midea* (Hubner), which occurs widely and commonly throughout southeastern Ohio. Because the females of *F. midea* are very difficult to separate from *E. olympia* while in flight, it is likely that *E. olympia* may easily be overlooked by collectors not actively seeking it.

Habitat Requirements: So far, this species has been captured on ridgetops in and adjacent to open oak woodlands (Calhoun 1985[86]). It uses several species of rock cress as host plants (Clench and Opler 1983). The most likely candidate in Lawrence County is *Arabis laevigata* (Muhl.) (Riddlebarger 1984), a common plant species in southern Ohio that inhabits dry to moist woods (Cusick and Silberhorn 1977).

Potentials for Decline: The limited range of this species may make it susceptible to gypsy moth control measures if they are implemented.

Satyrium edwardsii (Grote and Robinson) - Edward's Hairstreak

Historical Occurrence in Ohio: Reported in error as being common in northwest Ohio (Price 1970, Albrecht 1982), this species is actually known from just a few records from outside of the Oak Openings (Shuey, Iftner, and Calhoun 1985[86]). The few historical records available indicate that it may have been fairly widespread at one time.

Current Status in Ohio: Viable populations are known from two widely separated regions of the state. Several populations are known from the Oak Openings region; one population is known from Scioto County, in southern Ohio.

Habitat Requirements: In the Oak Openings this species is associated with open oak savannas containing native prairie understories. In Scioto County, it occurs on a xeric ridgetop notable for the presence of several prairie species (Cusick and Troutman 1978). Both areas in Ohio where *S. edwardsii* occurs are xeric habitats supporting numerous prairie plants. In both areas the host plants are probably any of several species of oaks (*Quercus*) present. In southern Michigan, this species is myrmecophilic with the ant species, *Formica integra* Nylander (Webster and Nielsen 1984). This may be the key to its limited distribution in Ohio (Shuey, Iftner, and Calhoun 1985[86]).

Potentials for Decline: The Oak Openings populations will be at risk if the remaining oak savannas are allowed through succession to become forests. The policy of fire suppression in Lucas County has already eliminated most of the suitable habitat for this butterfly in the Oak Openings. The Scioto County population is threatened by possible gypsy moth control measures in southern Ohio.

Speyeria idalia (Drury) - Regal Fritillary

Historical Occurrence in Ohio: This species has been recorded from over one-half of Ohio's counties, although records for western Ohio are sparse (Shuey et al. 1987).

Status in Ohio: The majority of the recent records for this species have come from unglaciated southeastern Ohio, although there are some records from a few north-central counties (Shuey et al. 1987).

Habitat Requirements: Most literature reports state that this is a species of the undisturbed prairie (e.g., Hammond and McCorkle (1983[84], Opler and Krizek 1984). This species is most often seen in mesic fields in southeastern Ohio, often in pastures, recently abandoned fields, and hay fields, but always near a woodland border.

At Resthaven Wildlife Area (Erie County) this species occurs in undisturbed and disturbed prairie situations. The usually reported host plant, bird's foot violet, (*Viola pedata* L.), is too rare to be the host throughout Ohio, so other violets are probably used (Shuey et al. 1987).

Potentials for Decline: Hammond and McCorkle (1983[84]) reported that most populations of this species declined concurrently with the destruction of vast expanses of native prairie. Johnson (1982-84[86]) considered this species to be sensitive to shifts in the species composition of its habitat. We have noted the extinction of one population in central Ohio that coincided with the localized elimination of nectar sources. An explanation (other than outright habitat destruction) for the decline of this species has never been proposed. In Ohio, this species seems relatively secure in the southeastern counties, but the general decline of this species could conceivably continue. This decline could be hastened if widespread gypsy moth control measures are implemented.

EXTIRPATED SPECIES IN OHIO

Neonympha mitchellii French - Mitchell's Satyr

Historical Occurrence in Ohio: This species was first reported by Pallister (1927) in Streetsboro Fen, Portage County, where he found it on 4 July 1925 and 10 July 1926. According to McAlpine et al. (1960), it was last reported from Streetsboro Fen on 19 June 1950. By 1954, most of Streetsboro Fen had been converted to a truck farm. Recent attempts to rediscover this species in suitable fens in northeast Ohio have been unsuccessful (Shuey et al. 1987). Although there are still seemingly suitable habitats that have not been surveyed, we consider this species to be extirpated, since it was last reported from Ohio over 30 years ago.

Recently, a disturbing development regarding this species has occurred. Larvae of *N. mitchellii* from southern Michigan have been introduced into Gott Fen State Nature Preserve, a remnant of Streetsboro Fen. The implications of this are two-fold. First, this jeopardizes any attempts at preserving native Ohio populations (if present) by putting in question their authenticity. The state of Ohio has no responsibility to protect non-native populations, thus jeopardizing conservation efforts for undetected native populations. Second, if undiscovered native populations do exist, they may be genetically swamped by this introduction. The Streetsboro populations were approximately 200 km from the nearest known populations in Michigan. Streetsboro is the only known area where this species has been recorded between Michigan and New Jersey. Thus, the Ohio populations have probably been isolated for several thousand years (Shapiro 1970) and are probably genetically unique. As such, they are scientifically very important; hence the introduction of *N. mitchellii* collected from other areas would jeopardize the gene pool of the Ohio populations.

Habitat Requirements: All of the known population sites for this species are fens (Shuey 1985). The larval host plant is probably *Carex stricta* Lam., a common sedge in many fens. Reliable indicator plants for potential *N. mitchellii* habitats include tamarack (*Larix laricina* [Du Roi]), poison sumac (*Rhus vernax* L.), shrubby cinquefoil (*Potentilla fruticosa* L.), and abundant sedges. This species has a strong preference for flying in open stands of tamarack surrounded by lush stands of sedges. There are still fens in northeastern Ohio that fit this general description; most have not been checked for populations of *N. mitchellii*.

Reasons for Extirpation: The extinction of the Streetsboro population was probably a direct consequence of draining major portions of this wetland for agricultural purposes. Many other potentially suitable wetlands in the general vicinity suffered similar fates. In the past, the fens occasionally burned, thus creating an open habitat. Because of fire suppression, many of the fens in northeastern Ohio are now grown over by various dogwoods (*Cornus*) and willows (*Salix*), which make then unsuitable as *N. mitchellii* habitat.

Pieris napi L. - Mustard White

Historical Status in Ohio: Henninger (1910) reported that a specimen of this species was collected on 6 July 1905 in Seneca County. Kirtland (1854) reported that it occurred at Toledo, "but east of the latter place (Toledo) it does not exist in our state". Scudder (1889) reported this species from Toledo, and referenced Kirtland as his source.

Habitat Requirements: The host plant in northeastern Indiana is watercress, (*Nasturtium officinale* R. Br.) (Shull 1977), a completely naturalized species that is often common in fens (Voss 1985). The native host plant in these situations is unknown, but is certainly a mustard (Cruciferae) (Chew 1977).

Reasons for Extirpation: In his description of original flora of the Oak Openings, Moseley (1928) described the area as containing large expanses of wet prairie between the raised xeric dunes. It seems likely that many of Moseley's wet prairies were fens (Andreas 1985), and that these areas could have supported populations of *P. napi* as reported by Kirtland (1854). Virtually all of these wet prairies are now destroyed and the butterfly fauna of the few remnants is well known. There is little chance that *P. napi* survives undetected in this area.

Speyeria diana (Cramer) - Diana Fritillary

Historical Occurrence in Ohio: The first reports of this species in Ohio were in Edwards (1884) and Holland (1898) who remarked that it was "occasionally found in the southern portion of Ohio." Hine (1898b) reported "a specimen . . . captured in Medina County August 9, 1897," "much rubbed . . . and probably flew there from farther south." Wyss (1932) reported that it was rare near Cincinnati. Charles Oehler (pers. comm.) reported that he and his friends collected specimens in and around Cincinnati (Hamilton County) in the early 1900s. Several additional specimens with vague data from southeastern Ohio and one from Franklin County (a probable stray) are also known.

This species probably occurred throughout the hill country of southern Ohio, but was very likely eliminated by the rapid and thorough deforestation that occurred during the iron smelting period in the late 1800s and early 1900s. Hammond and McCorkle (1983[84]) reported that *S. diana* suffered a similar decline throughout its range, but is now beginning to return to previously occupied areas as second-growth forests mature. It is possible that this species will eventually be rediscovered in southern Ohio.

STATUS UNKNOWN IN OHIO

Erynnis lucilius (Scudder and Burgess) - Columbine Dusky Wing

This species is known from two specimens collected from the Oak Openings of Lucas County. These specimens were determined as "probably *E. lucilius*" by Dr. J. Burns (see *E. persius*). This species is usually closely associated with its host plant, columbine (*Aquilegia* sp.). The best determination of the species is the discovery of a population that uses columbine as the host plant.

The two probable specimens of *E. lucilius* were caught several years apart, indicating that populations may exist in the Oak Openings. This species may be overlooked because of its very similar appearance to the six other *Erynnis* species that occur in Lucas county.

Amblyscirtes belli Freeman - Bell's Roadside Skipper

This species is known from a single specimen from Clermont County (April, 1938) deposited in the Cincinnati Museum of Natural History. The host plant, wild oats (*Uniola latifolia* Michx.), occurs commonly along the Ohio River and feeder streams in southern Ohio (Braun 1967). In Missouri, *A. belli* is found in shaded ravines that contain the host plant (Heitzman 1965). This species could be resident in Ohio in similar habitats. Opler and Krizek (1984) indicated that *A. belli* occurs north to at least Louisville, Kentucky in the Ohio River Valley.

Pontia protodice (Boisduval and LeConte) - Checkered White

At least through the 1930s, this species was widespread throughout the state and was reported by most early collectors (Dury 1878, Kirtland 1854, Pilate 1882, Hine 1898a, Bales 1909, Henninger 1910). The spring brood of this species was last collected in Ohio in 1953. We can find no specimens collected from 1967 through 1981. All but one record since 1982 are from southern Ohio, and all are summer-brood adults.

At one time this species was probably a resident species, and spring-brood specimens were common in collections. Since 1982, efforts to obtain spring-brood material from sites where specimens were taken the previous summer have been unsuccessful, indicating that it may not overwinter in Ohio. However, this species is consistently collected in summer at certain sites along the Ohio River in Lawrence County and may be a resident along the river.

Pontia protodice uses several mustards as larval host plants and is usually seen in disturbed, open areas in southern Ohio. There has been much speculation regarding the decline of this species in the eastern United States. Klots (1951) felt that the naturalized populations of *Pieris rapae* L. may have competed with *P. protodice*, or that the presence of large numbers of *P. rapae* may have allowed parasites to build to large enough numbers to negatively affect native *Pieris* and closely related species. Pyle (1981) suggested that changing land use patterns may have reduced this species. However, in Ohio, old fields and other open, disturbed habitats have always been common. Perhaps the best explanation (Chew 1977) is that native whites cannot distinguish between native and naturalized mustards when ovipositing. Most naturalized mustards contain lethal quantities of mustard oils, and larvae are unable to develop on them. Given the abundance of many naturalized mustards in disturbed habitats, ovipositing females may not lay enough eggs on suitable hosts to maintain populations in Ohio.

Erora laeta (W. H. Edwards) - Early Hairstreak

This species is known from two localities in Ohio: Fort Hill State Memorial, Highland County (Porter and Thomas 1970) and from Brecksville, Cuyahoga County. Two captures, several years apart, are known from the Fort Hill locality, indicating the presence of a population. It has often been suggested (Opler and Krizek 1984, Klots and dos Passos 1981) that this seemingly very rare species may fly primarily in tree tops. Thus its rarity in collections may not be a reflection of biological reality, but rather a reflection of a collector's "good fortune."

Klots and dos Passos (1981) reported beech (*Fagus grandiflora* Ehrh.) and possibly beaked hazelnut (*Corylus cornuta* Marsh.) as the host plants of this species in New England. *Erora laeta* usually occurs in Canadian zone and transitional forests. Until more is known about the biology of this species in Ohio, no determination can be made of its status.

Lycaena epixanthe (Boisduval and LeConte) - Bog Copper

Kirtland (1854) first reported this species from Rockport, near Cleveland. Kirkpatrick (1864) also recorded the species, stating that it was not plentiful near Cleveland. He also reported the presence of two other species of copper butterflies, increasing the likelihood that he was correctly referring to *L. epixanthe.* Kirkpatrick was aware of material in Kirtland's possession, and it is possible that both records refer to the same material. Two general works (Klots 1951, Howe 1975) vaguely reported the occurrence of this species in northeastern Ohio. Rawson (1948) reported that J. Thomas and E. Thomas searched without success for this species "in a few cranberry bogs which remain in Ohio." We have no authenticated records for Ohio, although it is known to occur in extreme northwestern Pennsylvania (Prescott 1984) and in southeastern Michigan (Moore 1960). The cranberry host plants (*Vaccinium macrocarpon* L. and *V. oxycoccos* Ait.) and habitat (acid bogs) occur in northeastern Ohio, and this species may reside here. If populations are discovered, they would certainly deserve endangered status, based on the rarity of the habitat in Ohio.

Phyciodes pascoensis Wright (= *selenis* (Kirby) - Northern Pearl Crescent

This species is known from a single specimen collected near Cincinnati, Hamilton County (deposited in the Cincinnati Museum of Natural History and determined by C. Oliver). Viable populations are known from areas near Ohio in West Virginia and Michigan (Opler and Krizek 1984). This species is very similar to *Phyciodes tharos* (Drury), an abundant species throughout the state, and may be overlooked. *Phyciodes pascoensis* was only recently recognized as a distinct species from *P. tharos* (Oliver 1980, referred to as *P. tharos* "type B"). Few collectors have actively searched for *P. pascoensis* in Ohio.

The host plant of *P. pascoensis* is unknown, but larvae will feed on panicled aster (*Aster simplex* Willd.) in captivity (Opler and Krizek 1984). In nature, the adults probably use asters as oviposition substrates.

DISCUSSION

Table I summarizes the relationships between environment and rare butterflies in Ohio. The majority of the butterflies discussed are restricted to unique and identifiable habitats, whether fens, oak savannas, or clearings within forests. The presence of these butterflies can be used as a gauge of ecological integrity of many of these communities. For example, the lupine-feeding butterflies become extinct through succession long before the host plant becomes noticeably affected. The presence of lupine-feeding butterflies indicates a dynamic community in which succession has been curtailed through periodic disturbance, a natural feature of the Oak Openings ecosystem. The other butterflies may be indicative of similar processes.

Two major threats to butterfly diversity in Ohio are easily identified. The first involves the loss of the five or more imperiled species (*E. persius, I. irus, L. melissa samuelis, B. selene,* and *S. edwardsii*) in the Oak Openings owing to uninterrupted succession. If these species are to remain part of Ohio's natural heritage, their habitats, especially in the Oak Openings Metro Park, Kitty Todd Preserve, and the various State Nature Preserves, must be managed in such a way as to preserve the biotic diversity that they were created to protect. Much of the critical habitat for these species has already been preserved because of the unique botanical communities present, but they have suffered from benign neglect. The butterflies currently threatened by this trend are simply conspicuous elements that are indicative of a larger process of insect extirpation from the region.

The second threat to Ohio's butterflies has far reaching consequences. If Dimilin is sprayed over major portions of southern Ohio to protect the forests from gypsy moth defoliation, there may be major extirpations of arthro-

TABLE 1

Summary of status, occurrence, and habitat requirements of critically rare Ohio butterflies. Factors negatively affecting these species are also given. Status abbreviations: Endang. = endangered, Threat. = threatened, Potent. Threat. = potentially threatened, Extir. = extirpated, ? = unknown. Occurrence abbreviations: A-Athens Co., Cl-Clermont Co., Ch-Champaign Co., Cu-Cuyahoga Co., Fr-Franklin Co., Fu-Fulton Co., Ha-Hamilton Co., Hi-Highland Co., Ho-Hocking Co., La-Lawrence Co., Lo-Logan Co., Lu-Lucas Co., P-Portage Co., Sc-Scioto Co., Se-Seneca Co., Tr-Trumbull Co., Tu-Tuscarawas Co., and V-Vinton Co.

Species	Status	Historical occurrence	Present occurrence	Host plant	Habitat	Reasons/potentials for decline
Erynnis persius	Endang.	Lu	Lu	*Lupinus*	Oak savanna/ dunes	Habitat succession
Erynnis lucilius	?	Lu	?	*Aquilegia*	Oak openings?	?
Pyrgus centaureae wyandot	Potent. Threat.	A, Cu, Ho V	A, Ho, V	*Potentilla canadensis?*	Forest clearings	Gypsy moth control
Amblyscirtes belli	?	Cl	?	*Uniola latifolia*	Shaded ravines	?
Pontia protodice	?	Statewide	Southern Ohio	Cruciferae	Disturbed fields	?
Pieris napi	Extir.	Lu, Se	—	?	Fens?	Habitat modification
Euchloe olympia	Potent. Threat.	La	La	*Arabis?*	Oak woodlands	Gypsy moth control
Lycaena epixanthe	?	?	?	*Vaccinium oxycoccos & macrocarpon*	Acid bogs	?
Satyrium edwardsii	Potent. Threat.	Cu, Fr, Lu, Sc, Tu	Lu, Sc	*Quercus*	Oak savanna-ridgetops	Succession, gypsy moth control
Incisalia irus	Endang.	Ha, Lu	Lu	*Lupinus*	Oak savanna/ dunes	Habitat succession
Erora laeta	?	Cu, Hi	?	*Fagus, Corylus?*	Beech forest	?
Lycaeides melissa samuelis	Endang.	Lu	Lu?	*Lupinus*	Oak savanna/ dunes	Habitat succession
Calephelis muticum	Endang.	Ch, Lo, Se?	Ch, Lo	*Cirsium muticum*	Fens	Habitat modification
Speyeria diana	Extir.	Ha, s-Ohio	—	*Viola*	Deciduous forests	Deforestation
Speyeria idalia	Potent. Threat.	Statewide	Unglaciated Ohio	*Viola*	Prairies, old fields	Habitat modification?
Boloria selene	Threat.	n-Ohio	Fu, Lo?, Lu, Tr	*Viola*	Fens, wet meadows	Habitat modification?
Phyciodes pascoensis	?	Ha	?	*Aster*	?	?
Neonympha mitchellii	Extir.	Po	—	*Carex stricta?*	Fens	Habitat modification

pods from the region. Various features such as topography and proximity to the Appalachian Mountains make this botanically the most diverse region of Ohio (Cusick and Silberhorn 1977). It is likewise the most entomologically diverse region of the state. Although we identify only three butterflies (*P. centaureae wyandot, E. olympia,* and *S. edwardsii*) that are highly susceptible to widespread spraying, there are nearly a dozen species of Noctuiidae that are readily identified as susceptible (E. Metzler pers. comm.). Given the failure of other states in the eastern United States to control the gypsy moth, any attempt to eradicate this species from Ohio would seem futile. It seems obvious that the gypsy moth is here to stay, and that it is economically infeasible to spray for this species in perpetuity. Severe ecological damage may be inflicted while trying to prevent short-term defoliation by this moth. This could result in the extirpation of untold numbers of arthropods from Ohio.

We hope that this paper will be used to guide future research and land management decisions, and not as justification for statewide collecting restrictions on certain species. Insect collecting, intelligently done, can yield real benefits to society. This paper is based primarily upon data obtained from private collections. Restrictions on collecting may only make it more difficult for researchers to obtain data while having little real impact upon collecting. Those species that are truly sensitive to collecting pressure are best protected through land acquisition by conservation groups.

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